

CLOUD DROPLET EFFECTIVE RADIUS DERIVED FROM GROUND-BASED REMOTE SENSING AT THE ARM SGP AND NSA SITES

B. Kim, S. E. Schwartz, and M. A. Miller
Environmental Sciences Department
Brookhaven National Laboratory
Upton, NY 11973-5000

Q. Min
Atmospheric Science Research Center
State University of New York at Albany
100 Fuller Road
Albany, NY 12205

October 2002

For presentation at the
American Geophysical Union 2002 Annual Meeting
San Francisco, CA
Dec. 6-10, 2002

ABSTRACT

Aerosols affect global climate directly, by scattering or absorbing radiation, and indirectly, by altering cloud microphysical and radiative properties. However quantification of these effects has been limited, especially the indirect effect. The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) program established the Southern Great Plains (SGP, north-central Oklahoma) and North Slope of Alaska (NSA, near Barrow) Cloud and Radiation Testbed sites to conduct multiple continuous in-situ and remote measurements of radiation and cloud and aerosol properties over extended periods. Here we examine remotely sensed microphysical properties of low clouds and relations to aerosol loading at the surface at the SGP and NSA sites for the year 2000. Widespread low-level water cloud layers without interference from higher-level ice clouds are most favorable for testing relations between radiation and microphysical properties. Suitable cases were carefully selected by examination of time series for cloud layers (mainly from cloud radar), liquid water path (LWP, microwave radiometer) in excess of 100 g m⁻², and direct and diffuse solar irradiance (pyranometers). Spectral diffuse-horizontal irradiance relative to top of atmosphere was measured by a Multi-Filter Rotating Shadowband Radiometer (MFRSR); cloud optical depth was obtained using the observed atmospheric transmittance and surface albedo (Min and Harrison, GRL, 1996) for solar zenith angle (SZA) less than 75°. Situations of low-level and thin cloud layer are much less prevalent at SGP than at NSA, which is influenced by marine boundary layer cloud but limited by the SZA requirement. The primary controlling influence on cloud optical depth is LWP, with microphysics exerting a smaller influence that is discernible from differences in slopes graphs of optical depth vs. LWP (Schwartz et al., PNAS, 2002). Continental clouds exhibit low effective radii (typically 6-10 µm) indicative of strong aerosol influence.